# Space Weather Technical Forecast

Issued on Friday, 11 February 2022 at 01:19 Local

**This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

## Space Weather Forecast Headline: Slight chance of G1/Minor Storm early today, then Chance of a G1 tomorrow (12 Feb) or on day 3 (13 Feb). Active electron fluence probably slowly declining. Chance of an M-class flare.

## Analysis of Space Weather Activity over past 24 hours

**Solar Activity:** Solar activity has been low over the last 24 hours, with several C-class flares. The most energetic of these was a C3.7 at 10/0437 UTC from AR2941, a region in the northern hemisphere which is large but magnetically simple. There are three other numbered regions on the visible disc: AR2939 and AR2944 in the southwest, and AR2940 which is approaching the northwest limb and so is becoming difficult to see and classify. These regions are small, relatively simple and stable. There are also two new regions in the southwest quadrant, and another new region rotating into view from the southeast limb, all small and magnetically simple. No Earth directed CMEs have been observed in available imagery.

**Solar Wind / Geomagnetic Activity:** The solar wind as measured by DSCOVR at L1 was at predominantly slightly elevated levels, peaking at 452 km/s at 10/1429 UTC, then declined to background levels, around 380 km/s, at the very end of the day. The density was above average until early afternoon, peaking at 18 ppcc, thereafter decreasing to below average or average values. The IMF was steady and moderate throughout, peaking at 13 nT at 10/1516 UTC. The north-south component, Bz, initially varied weakly but the fluctuations increased in strength through the morning, then from 10/1315 UTC the Bz became weakly or moderately negatively, reaching -13 nT at 10/1503 UTC. Phi angle remained negative (towards the Sun). Geomagnetic activity was initially Quiet to Unsettled (Kp 2-3) then increased Active to G1/Minor Storm (Kp 4-5) from 10/1500 UTC.

**Energetic Particles / Solar Radiation:** The high energy proton flux (greater than 10 MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2MeV) was initially above the High threshold (1000 pfu), then fell to mainly moderate levels between 10/0315-0935 UTC, after which the flux reached High levels again with the flux peaking at 7543 pfu at 10/1410 UTC. From 10/1705 UTC the flux fell below the High threshold. The corresponding electron fluence values were above the Active (1e8 integrated pfu) threshold throughout, but with a declining trend, ending the day at 1.27e8 integrated pfu at 10/2359 UTC.

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# Met Office Space Weather Technical Forecast

## Four-Day Space Weather Forecast Summary

**Solar Activity:** Solar activity is forecast to remain low through the next four days, with a chance of an isolated M-class flare, mainly from AR2941.

**Solar Wind / Geomagnetic Activity:** Residual CME effects, from the CME which left the Sun on 06 February and arrived at 09/2010UTC, are likely to gradually ease through today. The high speed stream from coronal hole 53 is then expected arrive either later tomorrow (12 Feb) or more likely through day 3 (13 Feb), with speeds eventually reaching 600 km/s. Geomagnetic activity is expected to start Quiet to Active (Kp 2-4) with a Slight Chance of G1/Minor Storms (Kp 5), due to residual CME effects. Quiet to Unsettled conditions are expected tomorrow, increasing Unsettled to Active conditions for days 3 and 4 (13th and 14th) with isolated G1/Minor Storm intervals likely day 3 (13th).

**Energetic Particles / Solar Radiation:** The high energy (greater than 10 MeV) proton flux is forecast to be at background levels, but with a slight chance of rising close to, or just above, the S1 level given any significant flares from the regions in the western hemisphere. The high energy electron flux is starting at low to moderate levels, but through today is expected to peak above the High threshold (1000 pfu), and is likely to do the same tomorrow and day 3 (12th and 13th) at the peak of the diurnal cycles. Day 4 (14th) the flux is likely to reach High values and remain there. Initially the corresponding fluence will show a declining trend, falling below the Active (1e8 integrated flux) through today. The fluence is likely to remain below the Active threshold tomorrow and day 3 (13th) before possibly increasing above the Active threshold during day 4 (14th) under the influence of the HSS from CH53. However, confidence is low regarding this.

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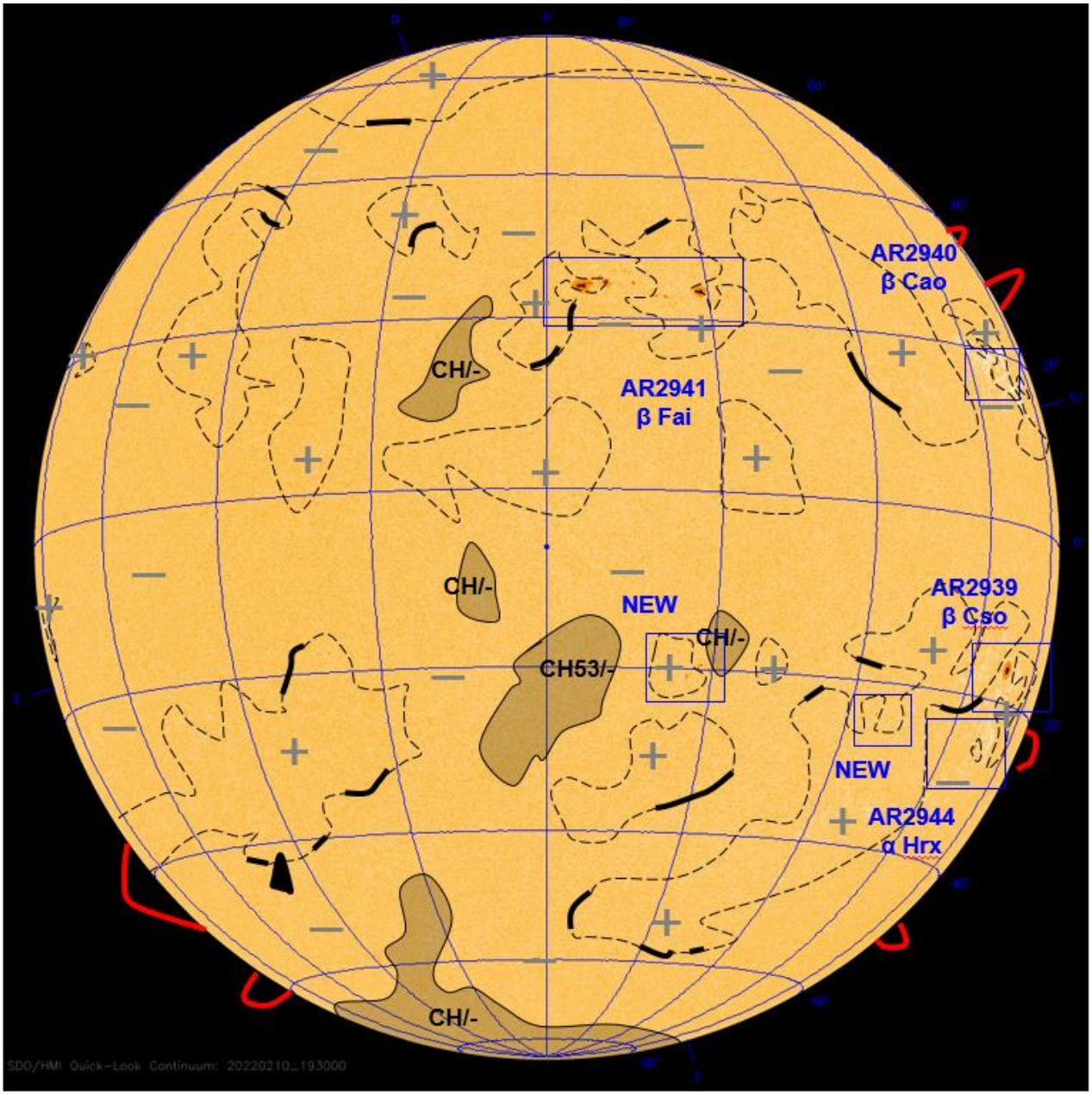
**Figure 1. Solar Analysis Valid 10/1930 UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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## Geomagnetic Storms:

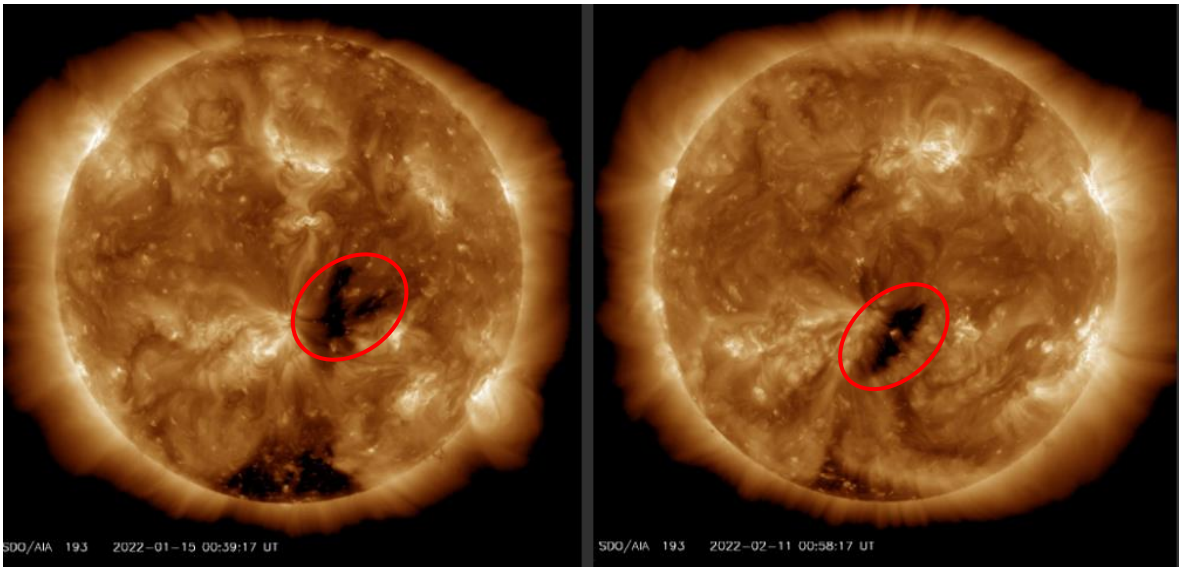
Residual CME effects, from the CME which left the Sun on 06 February and arrived at 09/2010UTC, are likely to gradually ease through today.

The next feature of interest will be the high speed stream from coronal hole 53, which looks set to arrive either late tomorrow (12 Feb) or more likely through day 3 (13 Feb), with peak of around or just above 600km/s, based on persistence from this recurrent feature.

Geomagnetic activity is expected to start Quiet to Active (Kp 2-4) with a Slight Chance of G1/Minor Storms (Kp 5), due to residual CME effects. Quiet to Unsettled conditions (Kp 2-3) are expected tomorrow, increasing Unsettled to Active (Kp 3-4) conditions for days 3 and 4 (13th and 14th) with isolated G1/Minor Storm intervals likely day 3 (13th).

| Geo-Magnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| Minor or Moderate | G1 to G2 | Yes | 20 | 30 | 60 | 30 |
| Strong | G3 | No | 1 | 1 | 5 | 1 |
| Severe | G4 | No | 1 | 1 | 1 | 1 |
| Extreme | G5 | No | 1 | 1 | 1 | 1 |

**Figure 2: SDO/AIA 193 imagery from the previous rotation (left) and currently (right) showing CH53, indicating a slightly further back position and so slower arrival compared to persistence forecasting.**

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# Met Office Space Weather Technical Forecast

## Radio Blackouts - X-Ray Flares:

Solar activity has been low over the last 24 hours, with several C-class flares. The most energetic of these was a C3.7 at 10/0437 UTC from AR2941, a region in the northern hemisphere which is large but magnetically simple, and appears to have lost some intermediate spots. There are three other numbered regions on the visible disc: AR2939 and AR2944 in the southwest, and AR2940 which is approaching the northwest limb and so is becoming difficult to see and classify. These regions are small, relatively simple and stable. There are also two new regions in the southwest quadrant, and another new region rotating into view from the southeast limb, all small and magnetically simple.

Solar activity is forecast to remain low through the next four days, with a chance of an isolated M-class flare, mainly from AR2941. A new region may rotate onto the visible disc late in the forecast period.

| X Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 M Class | No | 20 | 20 | 20 | 20 |
| Very Active | R3 to R5 X Class | No | 2 | 2 | 2 | 2 |

## Solar Radiation Storms - (High Energy Protons):

The high energy proton flux, as measured by GOES-16 is at background levels. Solar radiation storms are unlikely in the period. However, there is a very slight chance for proton fluxes to rise given any significant flaring from AR2940 but mainly from AR2941, as they continue to transit across the western hemisphere.

| Radiation Storms | Level ($cm^{-2}$ $sr^{-1}$ $s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ S1 | No | 5 | 5 | 5 | 5 |
| Very Active | ≥ S3 * | No | 1 | 1 | 1 | 1 |

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

## High Energy Electrons Event (≥ 2MeV):

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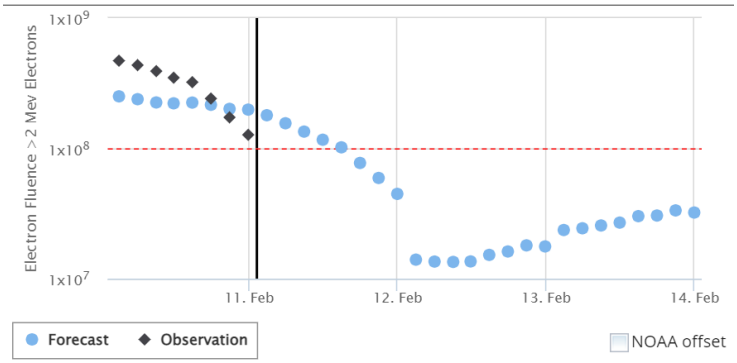
The high energy electron flux is starting below the High (1000 pfu) threshold as a result of geomagnetic activity yesterday. Once the activity eases the flux is expected to rebound, exceeding the High threshold again today, tomorrow and day 3 (13th) at the peaks of the diurnal cycles. During day 4 (14th) the flux is likely to reach High values and remain there.
Initially the corresponding fluence will show a declining trend, falling below the Active (1e8 integrated flux) through today. The fluence is likely to remain below the Active threshold tomorrow and day 3 (13th) before possibly increasing above the Active threshold during day 4 (14th) under the influence of the HSS from CH53. Therefore the Met Office REFM model is considered to be offering reasonable guidance.

However, confidence is low regarding the high energy electron flux, and therefore the fluence, due to the uncertain nature of the residual CME effects and also the influence of geomagnetic activity associated with the HSS from CH53.

| GEO Electron Environment<br>Probability (Exceedance) | Level ($cm^{-2}$ $sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC)<br>(%) | Day 2 (00-24 UTC)<br>(%) | Day 3 (00-24 UTC)<br>(%) | Day 4 (00-24 UTC)<br>(%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ 2 MeV ≥ $1x10^8$** | Yes | 100 | 40 | 40 | 60 |
| **Very Active** | **≥ 2 MeV ≥ $1x10^9$** | No | 2 | 1 | 1 | 1 |

**Figure 3: Met Office REFM Model**

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